Effects of Pesticides Applied During Almond Bloom on Post Emergence Mortality Rate of Honey Bees

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Background:

Almond and many other crops rely on honey bees for pollination. With the rapid declining of honey bee populations, we would not only see a decrease in almond production but a hit to a major agricultural market. Farmers commonly mix insecticides that are labeled as "bee-safe" with fungicides and apply them together during almond bloom. Synergistic effects of the products may increase the toxicity of insecticides to bees[1,2]. Therefore, understanding these effects is critical for developing pesticide application guidelines to minimize harm on pollinators.

Objectives:

- What effect does exposure to common almond insecticides, fungicides or combinations have on larval honey bee development?
- How do the insecticide and fungicide mixtures effect longevity of honey bees?

Method:

- Worker bee larvae were reared *in vitro* and fed with royal jelly-sugar-yeast extract diets following a standard protocol[3] (Figure 1)
- After acclimation, larvae were assigned to groups and treated with fungicides, insecticides, and insecticide-fungicide combinations commonly applied to almonds in bloom at maximal concentration ratios according to product labels. A solvent-only treatment (2% acetone) was included as the negative control
- 12 replicates, with 16 bees per replicate for each treatment (192 larvae total per treatment) were performed and the number of bees emerged as adults was recorded (Figure 2)
- After emergence, the mortality of adult bees was recorded for several consecutive days (Figure 3)

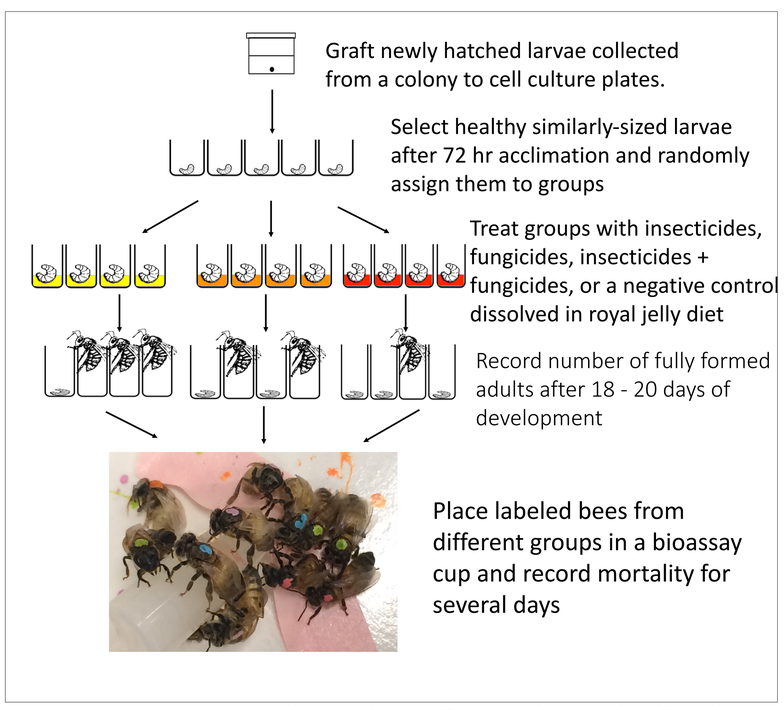


Figure 1. Experimental procedures of in vitro honey bee larval rearing

Results:

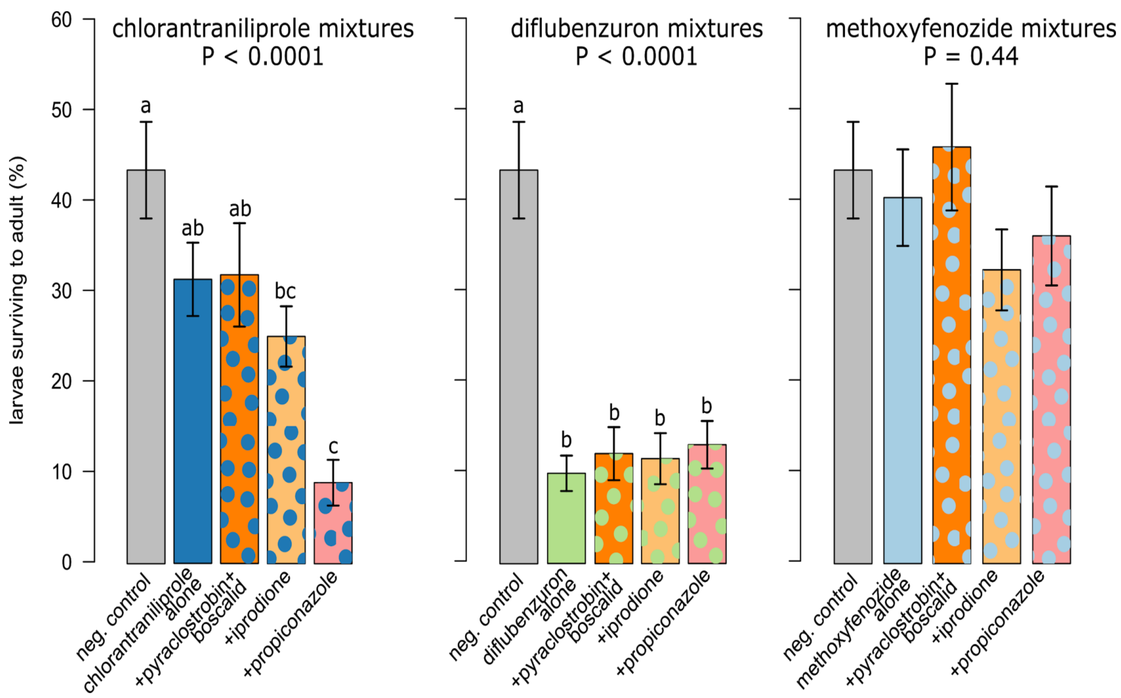


Figure 2. Survival of honey bee larvae treated with insecticides and insecticide-fungicide combinations.

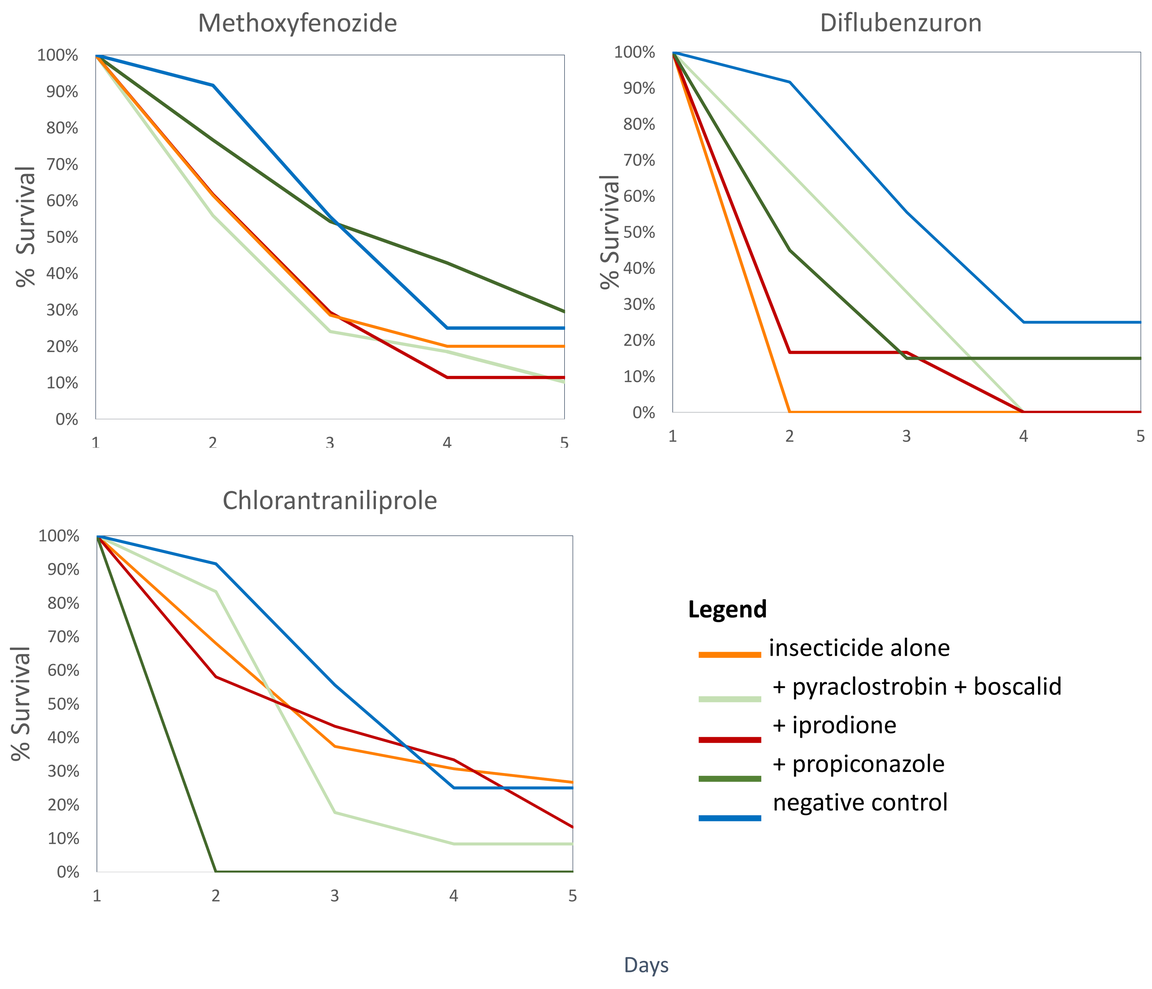
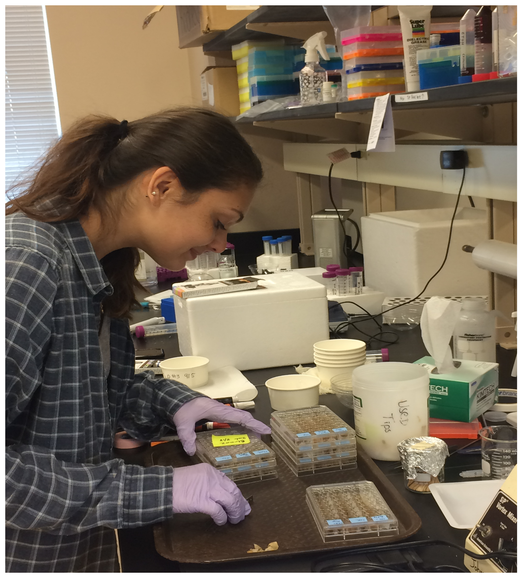


Figure 3. Survival of adult bees reared on royal jelly diets treated with insecticides alone, insecticide-fungicide combinations, or negative control

Conclusion:

- The fungicides propiconazole and iprodione significantly increased the toxicity of the insecticide chlorantraniliprole when applied at a tank-mix ratio. Diflubenzuron reduces larval survival whether applied alone or in combination with fungicides (Figure 2)
- Larvae exposed to methoxyfenozide alone and combined with fungicides survived at higher rates as adults than those exposed to chlorantraniliprole and diflubenzuron (Figure 3)
- Chlorantraniliprole with propiconazole in larval diet appeared to reduce survival in adults(Figure 3)
- Those working in the agricultural arena should be conscientious when applying tank-mixed insecticides and fungicides without knowing the effects
- Future research will focus on colony tolerance of insecticide/fungicide combinations



References:
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2. Johnson, R.M. and E.G. Percel. 2013. Effect of a fungicide and spray adjuvent on queen-rearing success in honey bees. Journal of Economic Entomology Vol. 106: 1952-1957
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